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# *STYLOCELLUS RAMBLAE*, A NEW STYLOCELLID (OPILIONES, CYPHOPHTHALMI) FROM SINGAPORE, WITH A DISCUSSION OF THE FAMILY STYLOCELLIDAE

**Gonzalo Giribet**: Department of Organismic and Evolutionary Biology, Harvard University, 16 Divinity Avenue, Cambridge, Massachusetts 02138, USA. E-mail: ggiribet@oeb.harvard.edu

**ABSTRACT.** A new *Stylocellus* from Singapore, the smallest species of the genus, is described and fully illustrated. The family Stylocellidae is rediagnosed and emended to include the representatives of the genera *Miopsalis* and *Fangensis* based on the results of a phylogenetic analysis of the cyphophthalmid genera (Giribet & Boyer 2002).

**Keywords:** Cyphophthalmi, Stylocellidae, *Stylocellus*, *Miopsalis*, *Fangensis*, *Leptosalis*

Hansen & Sørensen (1904) proposed the subfamily Stylocellini [sic] to include the genera *Stylocellus* Westwood 1874, *Ogovia* Hansen & Sørensen 1904, and *Miopsalis* Thorell 1890. The subfamily was raised to the full family status and emended to include only the genus *Stylocellus* (Shear 1979), and was later diagnosed (Shear 1980). The genus *Stylocellus* comprises about 24 described species of mostly large Cyphophthalmi inhabiting the tropical areas of southeast Asia including the Malay Peninsula and Malay Archipelago (Sumatra, Borneo, Java, Sulawesi and Palawan), and the Philippines (Giribet 2000; Hansen & Sørensen 1904; Rosas Costa 1950; Shear 1993). An unidentified species has also been reported from northern Thailand (Suzuki 1985) and recent material has been collected in the Malay Peninsula in Thailand by P. Schwendinger (pers. comm.).

The genus *Stylocellus* was established by Westwood, who described *S. sumatranus* from the island that gave the specific epithet (Westwood 1874). Other species followed from Borneo (Pocock 1897) and Java (Thorell 1882). Hansen and Sørensen (1904) revised the genus and added descriptions of five new species. Two additional species were later described from the Malay Peninsula and Borneo (Roewer 1942). W. A. Shear recently described twelve species of *Stylocellus*, doubling the number of described species (Shear 1979, 1993), and M. Rambla described another species from a cave system in Borneo (Rambla 1991).

*Leptopsalis beccarii* Thorell 1882 was described based on material from Mount Singalang in Sumatra (Indonesia). Subsequently, the species was erroneously synonymized with *Stylocellus sumatranus* Westwood 1874 (Thorell 1890/91). Despite its explicit treatment as a valid species by Hansen and Sørensen (1904), I mistakenly considered it a synonym of *S. sumatranus* (Giribet 2000). Clearly, *Leptopsalis beccarii* and *Stylocellus sumatranus* are two separate species that differ at least in their cheliceral morphology, *L. beccarii* bearing an unusual second ventral process on the basal article. All stylocellids, and most cyphophthalmids, have a ventral process on the chelicera while *L. beccarii* and the new species here described share the apomorphic condition of having a second ventral process (see Fig. 6). This extra ventral process has also been found in many other members of the genus *Stylocellus*, in *Fangensis leclerci* Rambla 1994, and in one putative new species of *Miopsalis* Thorell 1890.

Currently, stylocellids comprise the single genus *Stylocellus*, which contains all the Cyphophthalmi with eyes, and excludes all eyeless species of the suborder. The genus (and family) was diagnosed by Shear (1980) as follows: "Eyes present. Ozophores type 2. First coxae free, second coxae fused to third. Abdominal sternites eight and nine and tergite nine all free. Chelicerae distally attenuate, with dorsal crest, cheliceral teeth uniformly large. Ovipositor (when studied) with sense

organs. Male lacking anal glands and modifications of the anal region. Adenostyle short, triangular, thornlike; male tarsus 4 entire. Penis of Stylocellus type."

*Miopsalis pulicaria* Thorell 1890 is a species of Cyphophthalmi found in Southeast Asia that has been considered a *nomen dubium* by previous authors due to the deficient description, based probably on a female. I have not been able to examine the type material of the species, of about 2.2 mm in length, supposedly lodged in MCSN. A specimen of a small cyphophthalmid from Mulu National Park (Sarawak, Borneo) resembling a *Stylocellus* but lacking eyes has been recently reported as a possible representative of the genus *Miopsalis* (Shear 1993). I have examined this single female specimen, deposited in BMNH, and it presents all the characters of typical *Stylocellus* except for the eyes. This specimen is considerably smaller than *M. pulicaria*, measuring about 1.6 mm. Unfortunately, no males of this unnamed species are known. I have also examined a male specimen (1.4 mm) of a possible second undescribed species of *Miopsalis* from the Kapit District, also in Sarawak (deposited in FMAC), and again it presents all the typical stylocellid characters except for the eyes.

*Fangensis leclerci* is an interesting cyphophthalmid described from northern Thailand (Rambla 1994), occurring near the geographic area of the juvenile *Stylocellus* reported by Suzuki (1985). Originally proposed to belong to the Sironidae, *Fangensis* displays many stylocellid characters, such as the fused second coxae and the typical stylocellid spiracles shaped as a letter "C". I have not been able to locate the specimens described by M. Rambla, but the original description of the animals seems to fit within the limits of *Stylocellus* except again for the lack of eyes, the cheliceral morphology, and in the presence of anal glands (Juberthie 1962, 1967), a character so far only found in Sironidae and Pettalidae (Shear 1980).

I have also examined material of an undescribed species collected by P. Schwendinger in Ko Siray, a small island off Ko Phuket (Thailand) that fits within the description of *Fangensis*, although this undescribed species is larger that *F. leclerci*. The juveniles of this species also lack eyes, but bear a red pigmented area behind the ozophores that resembles a light sensitive organ, although this structure is not observed in the preserved juvenile specimens. I have not observed live adults, and therefore the existence of the "red spot" in the adults is unknown.

The examined specimens of *Miopsalis* and *Fangensis*, as well as the description of *Fangensis leclerci* made me evaluate the phylogenetic position of those taxa (see also the cladistic analysis of Giribet & Boyer 2002). In this article I describe the smallest *Stylocellus* known so far, from the Botanical Gardens of Singapore, and a new diagnosis of the Stylocellidae is proposed based on somatic characters, which should suffice to diagnose any adult specimen at the generic level.

## METHODS

**Abbreviations.**—Specimens are lodged in the following institutions:

AMNH = American Museum of Natural History, New York (USA); BMNH = The Natural History Museum, London (UK); FMHD = Field Museum of Natural History, Chicago (USA); FMAC = Field Museum of Natural History, Arachnid collection, Chicago (USA); MCSN = Museo Civico di Storia Naturale 'Giacomo Doria', Genova (Italy); MCZ = Museum of Comparative Zoology, Harvard University, Cambridge (USA); MHNG = Muséum d'histoire naturelle, Genève (Switzerland); SMF = Senckenberg Museum, Frankfurt am Main (Germany); WAM = Western Australian Museum, Perth (Australia); ZMB = Museum für Naturkunde, Zentralinstitut der Humboldt-Universität zu Berlin, Berlin (Germany); ZMUC = Zoological Museum, University of Copenhagen (Denmark).

**Diagnosis of Stylocellidae.**—Eyes present or absent. Ozophores type 2. First coxae free, second coxae fused to third. Fourth coxae of the male meeting in the midline. Spiracles in the form of a capital "C". Lack of male sternal secretory glands. Abdominal sternites eight and nine and tergite nine all free. Chelicerae with dorsal crest and one or two ventral protuberances, but variable in relative length and shape. Distal segment of the chelicerae ornamented near the base to almost entirely. Cheliceral teeth uniform. Modifications of the anal region absent. Male anal glands may be present (as in *Fangensis*) or absent (as in *Stylocellus* and *Miopsalis*). Male tarsus IV entire with short adenostyle tipped with a tuft


Figure 1.—Female *Stylocellus ramblae* new species, dorsal view. Scale bar = 1 mm.

of setae dorsally, not emerging from near the tarsal joint. Tarsus of leg I with a subapical modification where sensory hairs concentrate. Tarsus of leg II almost entirely ornamented. Claws of walking legs smooth. Ovipositor (when studied) with sense organs.

**Type genus.**—*Stylocellus* Westwood 1874

**Genera included.**—*Stylocellus* Westwood 1874; *Leptopsalis* Thorell 1882/83 (as *Stylocellus*); *Miopsalis* Thorell 1890; *Fangensis* Rambla 1991.

**Material examined.**—*Stylocellus collinsi* Shear 1993 (BMNH[E] 1999.167), *S. dumoga* Shear 1993 (BMNH[E] 1999.168), *S. gryllospecus* Shear 1993 (BMNH[E] 1999.169), *S. hillyardi* Shear 1993 (BMNH[E] 1999.170), *S. javanus* (Thorell, 1882) (AMNH; BMNH 56.102), *S. kinabalu* Shear 1993 (AMNH), *S. leakeyi* Shear 1993 (BMNH[E] 1999.171), *S. lionotus* Pocock 1897 (BMNH 95.7.20.23), *S. modestus* Hansen and Sørensen 1904 (ZMUC), *S. mulu* Shear 1993 (BMNH[E] 1999.172), *S. pangrango* Shear 1993 (AMNH), *S. pocockii* Hansen & Sørensen 1904 (BMNH no Register No.), *S. sabah* Shear 1993 (BMNH[E] 1999.173), *S. silhavyi* Rambla 1991 (Rambla collection), *S. tambusisi* Shear 1993 (BMNH[E] 1999.174), *S. thorellii* Hansen and Sørensen 1904 (ZMUC), *Stylocellus* sp. (Cokendolpher collection), *Stylocellus* sp. (ZMB 11495), *Fangensis* sp. (MHNG THMA-00/16), *Miopsalis* sp. (BMNH no Register No.), *Miopsalis* sp. (FMHD 72–310).

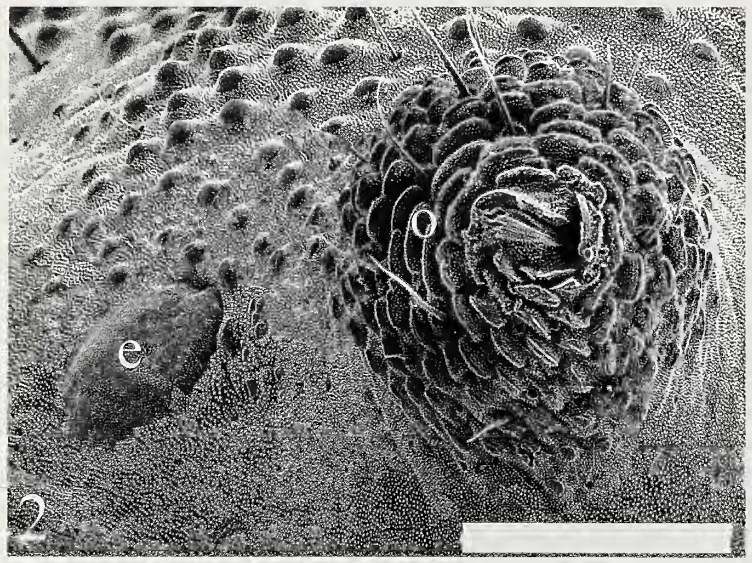
***Stylocellus ramblae*** new species
Figs. 1—20

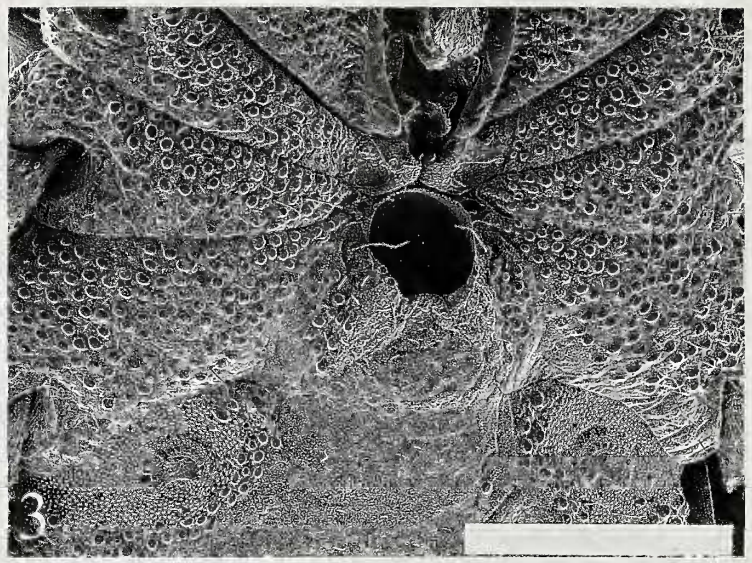
**Types.**—Holotype male from the Singapore Botanical Gardens (Singapore), collected 8 April 1981 by J. Kethley, in forest litter and buttress litter (sample FMHD 81–274) deposited at the FMAC 1; two female paratypes (FMAC 2), same collection data; one female paratype mounted on a SEM stub (MCZ 35137); one female paratype from MacRitchie Reservoir (Singapore), collected February 1950 by G.H. Lowe, deposited at the WAM (Arachnological collection 94/181).

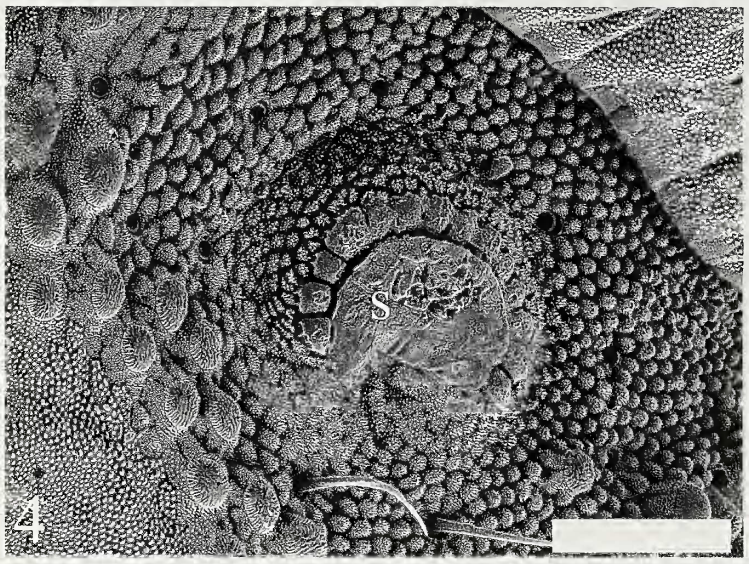
**Additional material.**—Six juveniles (FMHD 81–274), same collection data as holotype.

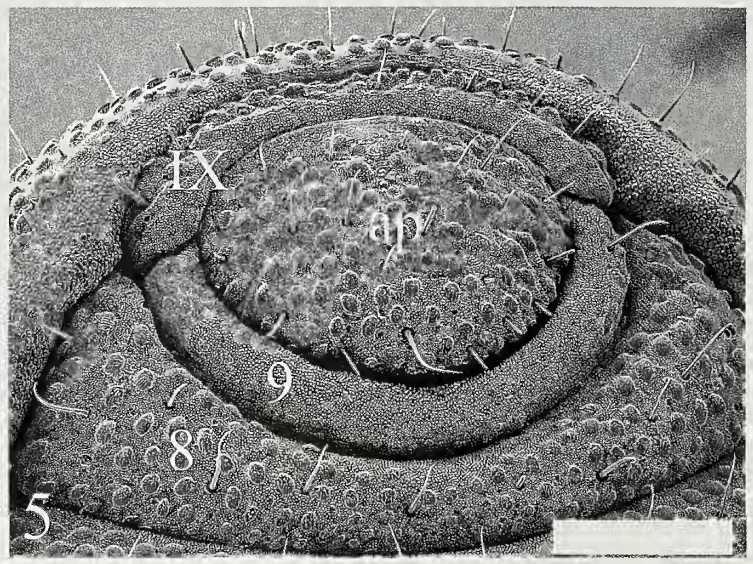
**Etymology.**—The species is named after my friend and colleague Maria Rambla, whose guidance inspired me to work on this fascinating group of Opiliones.

**Diagnosis.**—The species is related to other



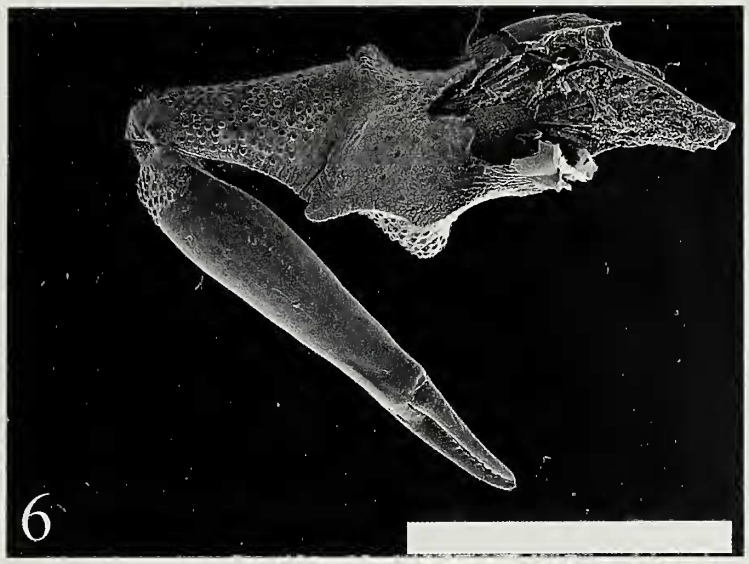



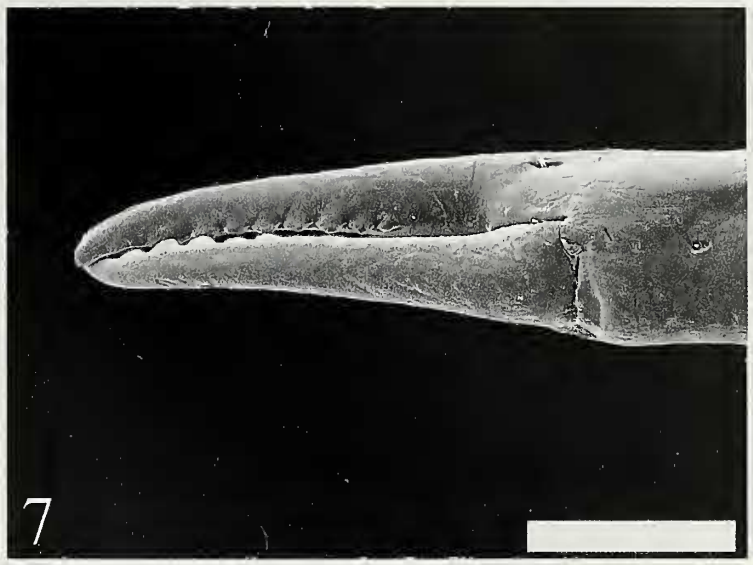

Figures 2–5.—*Stylocellus ramblae* new species, female: 2. Cephalic region in dorsolateral view showing the eye (e) and the ozophores (o); 3. Ventral thoracic complex; 4. Detail of the spiracular area with the spiracle (s) in the center; 5. Anal region showing the anal plate (ap) and the unfused sternites 8, 9, and tergite IX. Scale bars = 50 μm (Fig. 4), 100 μm (Figs. 2 & 5), 300 μm (Fig. 3).

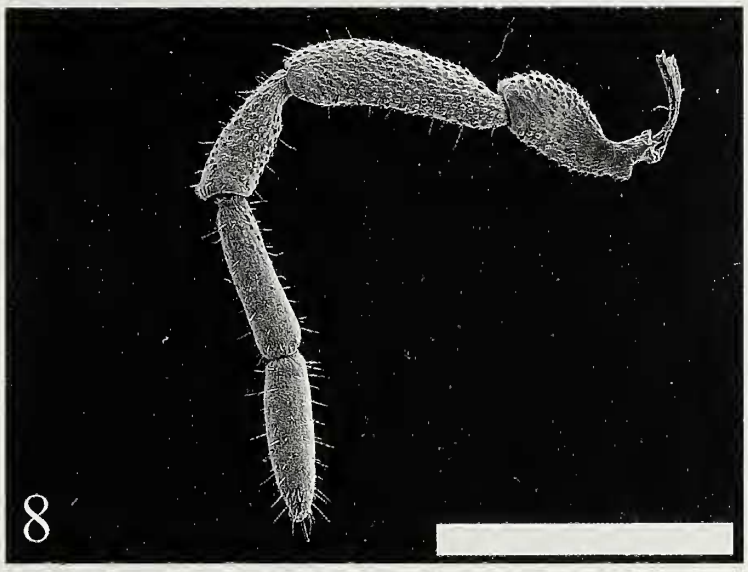
stylocellids showing a similar cheliceral type, such as *Stylocellus beccarii* (Thorell 1882). The special morphology of the tarsus I (Fig. 10) clearly separates this species from any other stylocellids. The small size of the adult specimens, near 2.4 mm in length, is only comparable with that of *Stylocellus kinabalu* Shear 1993 from Borneo. However, *S. ramblae* is a smaller species, and the length/width ratio is higher than that in *S. kinabalu* (2.1 vs 1.73). The closest species geographically is *S. laevichelis* Roewer 1942, from Malakka (Malaysia), a much larger species whose description is not accurate and which I have not been able to examine.

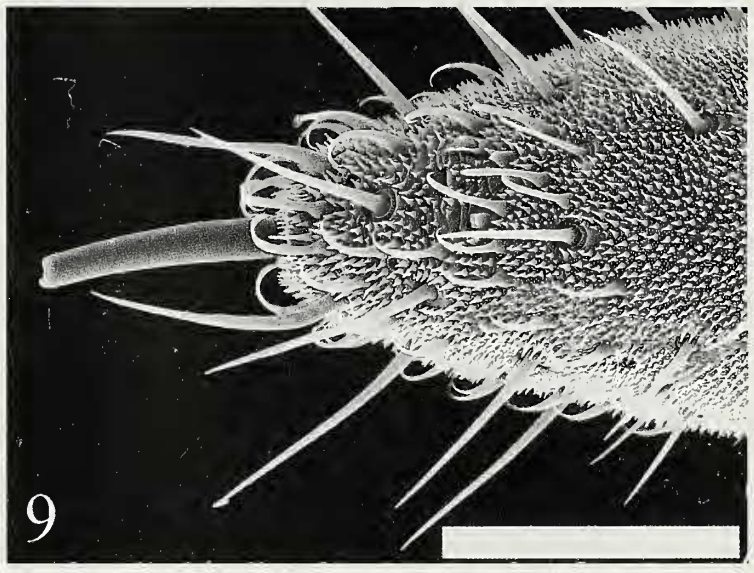
**Description.**—Male holotype (FMAC 1) and female paratype (measurements refer to the female paratype studied with the SEM: MCZ 35137) Total length 2.41 mm, width across ozophores 1.10 mm, greatest width 1.14 mm, length/with ratio 2.11 (Fig. 1). Animal reddish when preserved in 80% EtOH with most of the dorsal body surface and legs almost completely granulated (Fig. 1). Anterior margin of cephalothorax without lateral projections, and with a subtriangular shape, the base of the triangle formed at the base of the ozophores, and with a truncated end. Small eyes (75 μm at maximum diameter) located anterior to the ozophores (Fig. 2). Ozophores subcylindrical with a folded structure in the opening and measuring 146 μm in diameter (Fig. 2). Ozophores completely nippled, with sensory hairs. Cephalothoracic transverse sulcus pronounced. Transverse abdominal sulci distinct, mid-dorsal abdominal sulcus not present (Fig. 1).

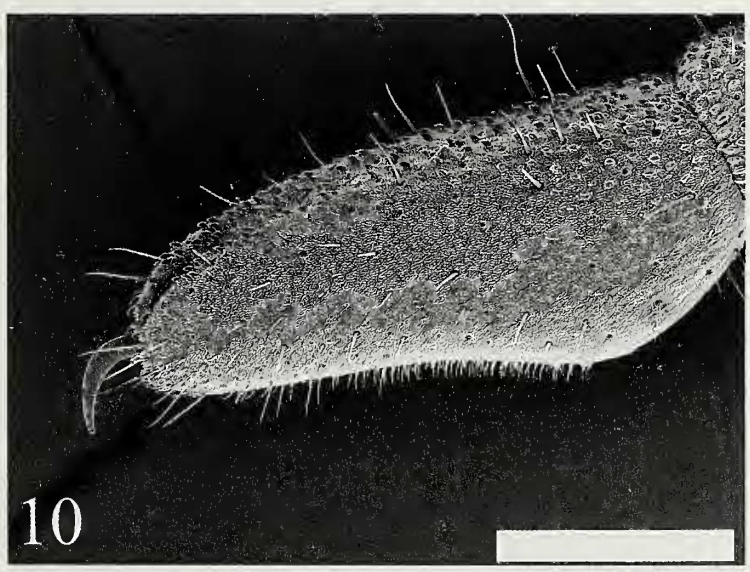
Coxa of leg I movable; coxa of the three remaining pairs of legs fused. Ventral thoracic complex of the male typical of stylocellids, with coxa III not meeting in the midline, and coxa II and IV meeting but not forming a long

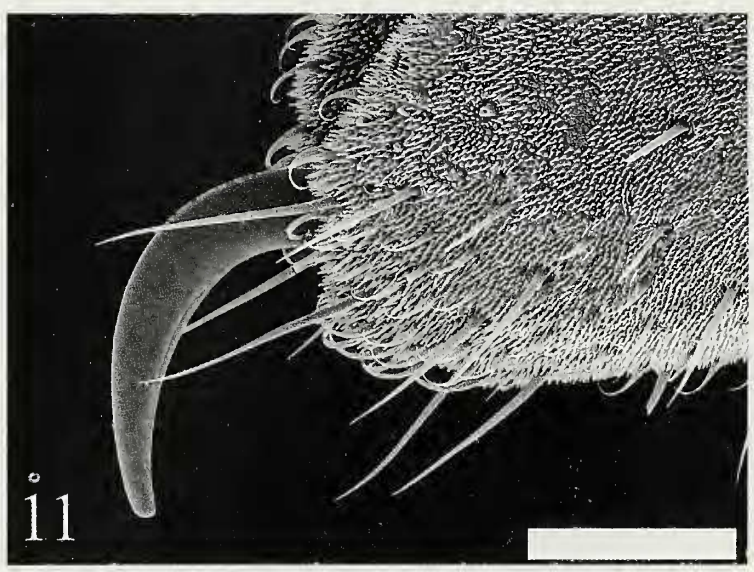


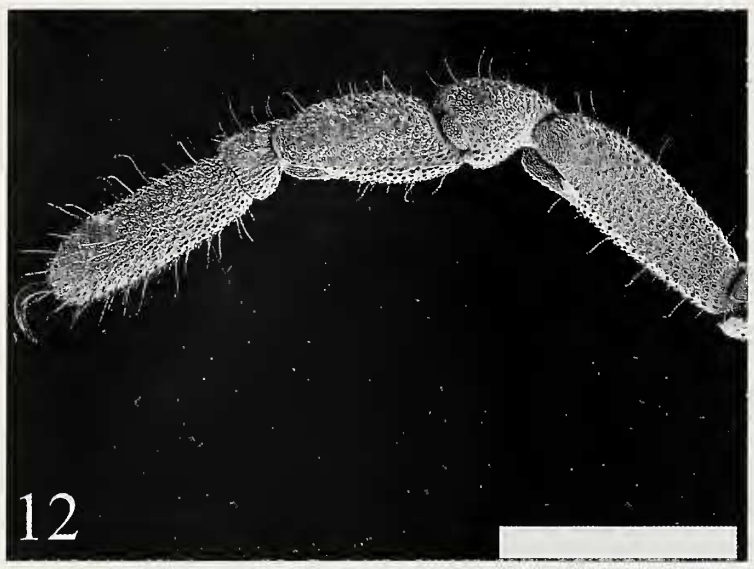



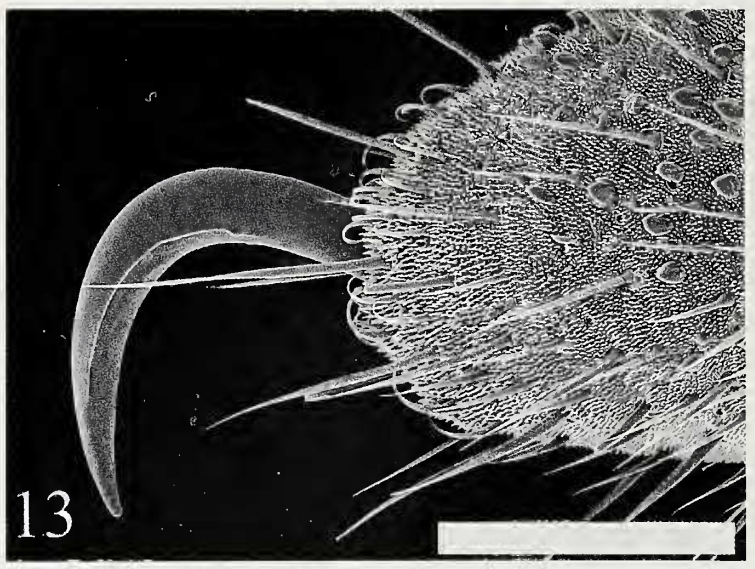



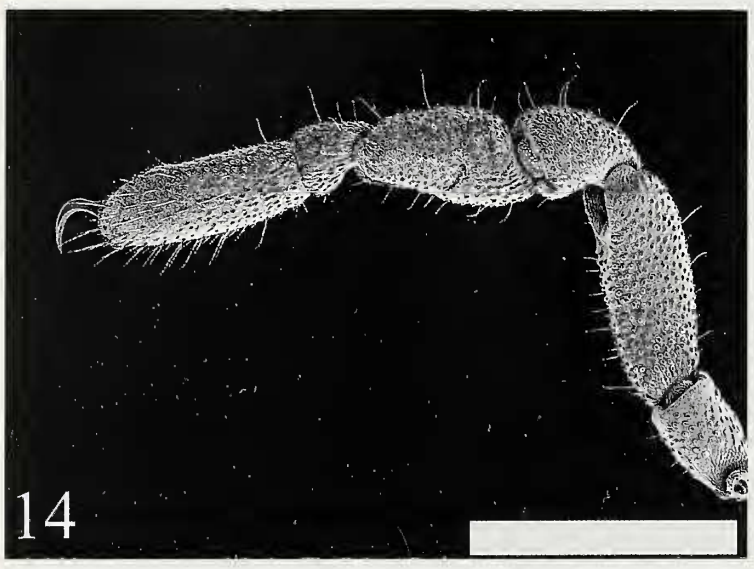

Figures 6–11.—*Stylocellus ramblae* new species, female: 6. External view of left chelicera showing the dorsal crest and the two ventral protuberances of the basal segment, and the ornamentation near the base of the distal segment; 7. Detail of the mobile digit and the dentition of the cheliceral distal segment; 8. Left palp; 9. Detail of the palpal claw; 10. Tarsal region of leg I; 11. Detail of tarsal claw I. Scale bars = 50 μm (Figs. 9, 11), 100 μm (Fig. 7), 200 μm (Fig. 10), 500 μm (Figs. 6 & 8).

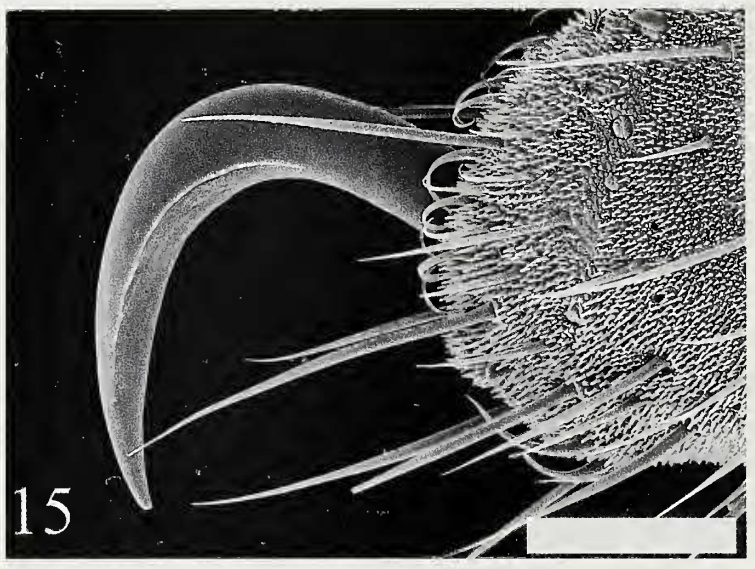
midline area. Gonostome wider than long. Posterior wall formed by the first apparent abdominal sternite clearly distinct, like a genital operculum. Ventral thoracic complex of the female (Fig. 3) also typical of stylocellids, with only coxae III meeting in the midline, while coxae IV adopt the typical tube-like shape directed anteroventrally.

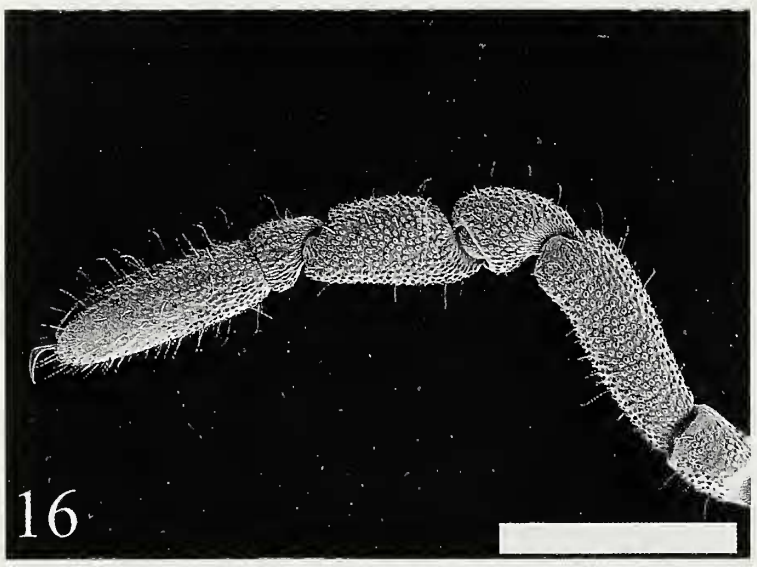
Spiracles shaped like a capital letter "C" (Fig. 4) and enclosed in an area with special cuticular structures. Sternites 8 and 9 and tergite IX free, not forming a complete corona

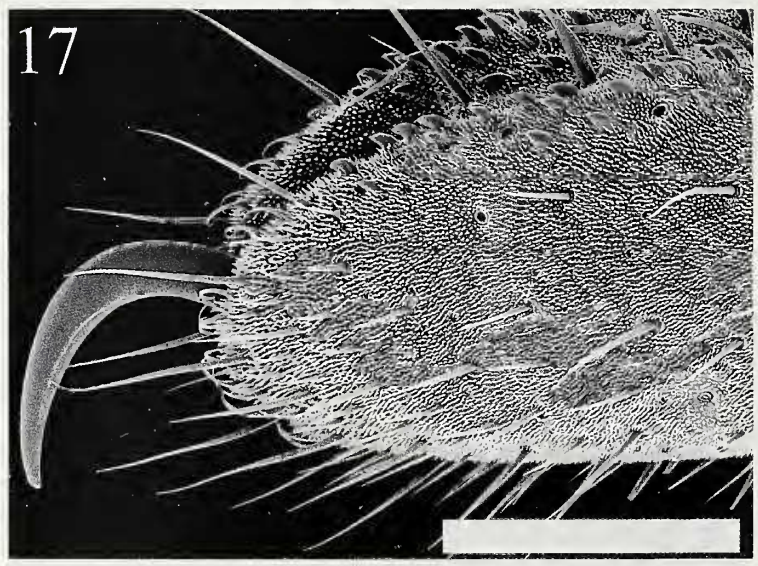



Figures 12–17.—*Stylocellus ramblae* new species, female: 12. Leg II; 13. Detail of tarsal claw II; 14. Leg III; 15. Detail of tarsal claw III; 16. Female leg IV; 17. Detail of tarsal claw IV. Scale bars = 50 μm (Figs. 15), 100 μm (Figs. 13 & 17), 500 μm (Figs. 12, 14, 16).

analis (Fig. 5). Male anal pore glands not detected and anal region not modified. Cuticle is granulated in all ventral areas, including coxae (Fig. 3) and anal region (Fig. 5).

Chelicerae short with the basal article granulated and presenting a dorsal crest and two ventral protuberances, the anterior one forming a ridge that unites it with the dorsal crest externally (Fig. 6). Distal article only ornamented near the joint, smooth otherwise. Total length of basal article 720 μm, length of distal article 800 μm, length of movable finger 240 μm. Dentition uniform and similar in both cheliceral fingers (Fig. 7).

Palps (Figs. 8, 9) with a ventral protuberance in the trochanter. Measurements of palpal segments (from basal to distal): 285, 395, 258, 298, 282 μm. Palpal claw 43 μm.

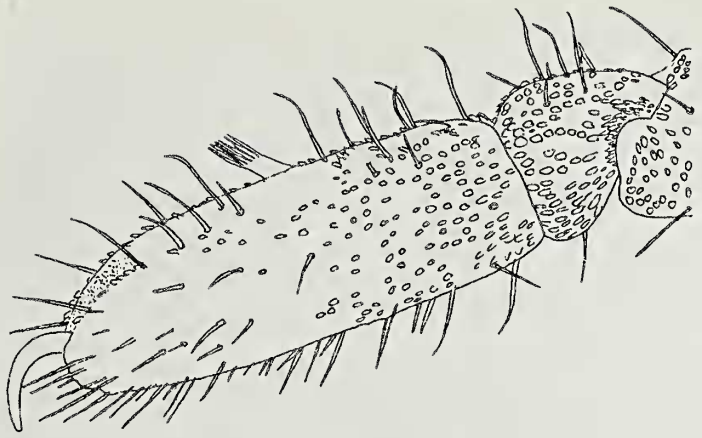


Figure 18.—Male tarsus IV showing the position of the adenostyle.

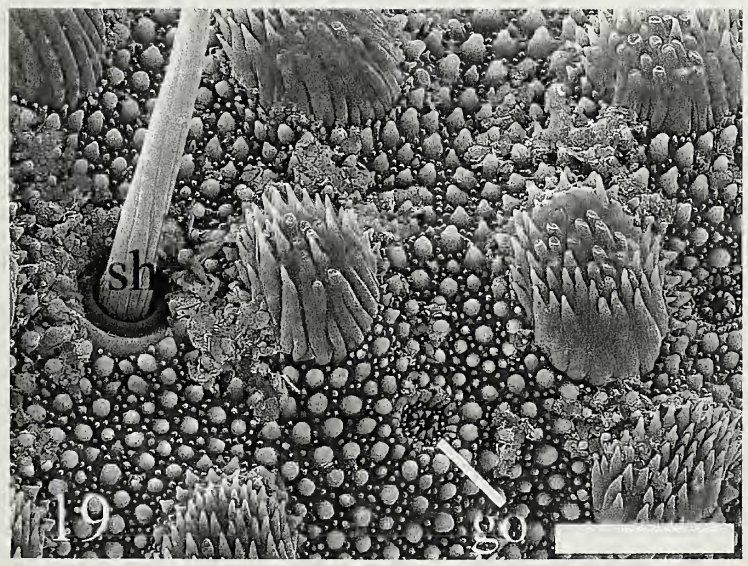
Legs with all claws smooth, without dentition or lateral pegs (Figs. 11, 13, 15 & 17). Surface of all articles, including metatarsi (= basitarsi) and tarsi (= telotarsi), clearly ornamented (Figs. 12, 14 & 16), except for the tarsi of leg I, where only the base and the dorsal surface are ornamented (Fig. 10). Tarsus of leg I swollen with a subapical modification with a concentration of sensory hairs that occupies about three quarters of the total tarsal length (Fig. 10). Tarsus IV of male entire with short adenostyle tipped with a tuft of setae dorsally at about halfway of the tarsal length (Fig. 18). Tarsus IV of female (Fig. 16) without modifications.

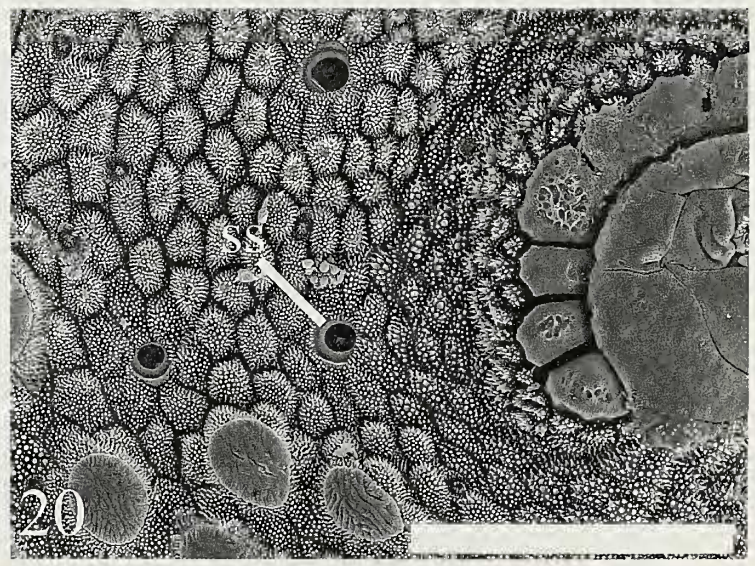
Penis (only the holotype is known) and ovipositor not studied.

**Cuticular structures.**—Cuticular structures of Cyphophthalmi have received attention recently through the use of SEM (Eisenbeis & Wichard 1985; Juberthie 1988, 1991; Legg 1990; Pabs-Garnon 1977; Rambla 1991). In *Stylocellus ramblae* the ultrastructure of the integument reflects the presence of numerous special structures. The integument is primarily formed by three main structures covering the body (triple ornamentation of Rambla 1991), one matrix of small denticles surrounding larger denticles, and a series of nipples (more or less modified) distributed throughout the cuticle (Fig. 19). The large nipples are generally rounded smooth protuberances slightly striated at the flanks, but they undergo several modifications in different body regions. The nipples of the ventral region gradually become brush-like when moving towards the posterior end of the body, and especially in the anal plate (Fig. 19). This typical triple ornamentation is accompanied by two other common integumental structures, sensory hairs of about 5 μm at the base, and glandular openings of about 3 μm in diameter (Fig. 19).

The spiracular area has richly ornamented polygonal structures (Fig. 20). Large nipples, glandular openings, and sensory openings are accompanied by other putative sensory structures (Fig. 20) that look like the base of the sensory hairs found all over the body. The large nipples of the ozophores adopt an elongated shape towards the tip, but are round at the base (Fig. 2). The eye surface shows polygonal shapes, and it is completely covered of small denticles.

**Distribution.**—Known from the type locality, the Botanical Gardens of Singapore,




Figures 19–20.—*Stylocellus ramblae* new species, female: 19. Detail of the cuticular structures of the anal plate showing the typical triple ornamentation, the sensory hairs (sh) and the glandular openings (go); 20. Detail of the spiracular area showing different cuticular structures, including a putative special type of sensory structures (ss). Scale bars = 10 μm (Fig. 19), 50 μm (Fig. 20).

and from the MacRitchie Reservoir in Singapore.

**Remarks.**—This species is supposedly related to other Stylocellidae with a second ventral process in the basal article of the chelicerae, and probably with only the basal part of the distal segment of chelicerae ornamented. This also occurs in *Stylocellus beccarii* (Thorell 1882), *S. javanus* (Thorell 1882), *S. modestus* Hansen & Sørensen 1904, *S. dumoga* Shear 1993, *S. hillyardi* Shear 1993, *S. kinabalu* Shear 1993, *S. mulu* Shear 1993, *S. pangrango* Shear 1993, and *S. tambusisi* Shear 1993. Other species not properly illustrated in the literature or unexamined by me may also belong to this group.

## DISCUSSION

*Stylocellus ramblae* clearly belongs to the family Stylocellidae, although its exact position within the family may require further investigation including all the putative stylocellid species. Preliminary data show that it is related to the clade having a second ventral process in the basal article of the chelicerae, a feature also shared with *Fangensis* and one species of *Miopsalis* (Giribet & Boyer 2002). I suspect that the type species of the genus, *S. sumatranus*, lacks the second cheliceral ventral process (as in *S. silhavyi* and *S. gryllospecus*), although I have not been able to examine specimens of this species. If this were confirmed, and all the stylocellids with the autapomorphic state were monophyletic, the resurrection of the genus *Leptopsalis* could be justified.

Penial characters have been widely used in cyphophthalmid taxonomy, including stylocellids (Hansen & Sørensen 1904; Rambla 1991, 1994; Shear 1979, 1993). Due to the uniqueness of the male holotype of *S. ramblae*, dissection for characterizing the penis seemed unwise since the species is easily diagnosed based on somatic and other secondary sexual characters.

Detailed SEM studies may reveal new characters to use in cyphophthalmid, and more specifically stylocellid, taxonomy and systematics. Pioneer work on stylocellid cuticular structures (Rambla 1991, 1994) together with the new data here presented suggest that an important number of characters are awaiting discovery and incorporation into the taxonomy of this fascinating but yet character-poor group of Opiliones.

## ACKNOWLEDGMENTS

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